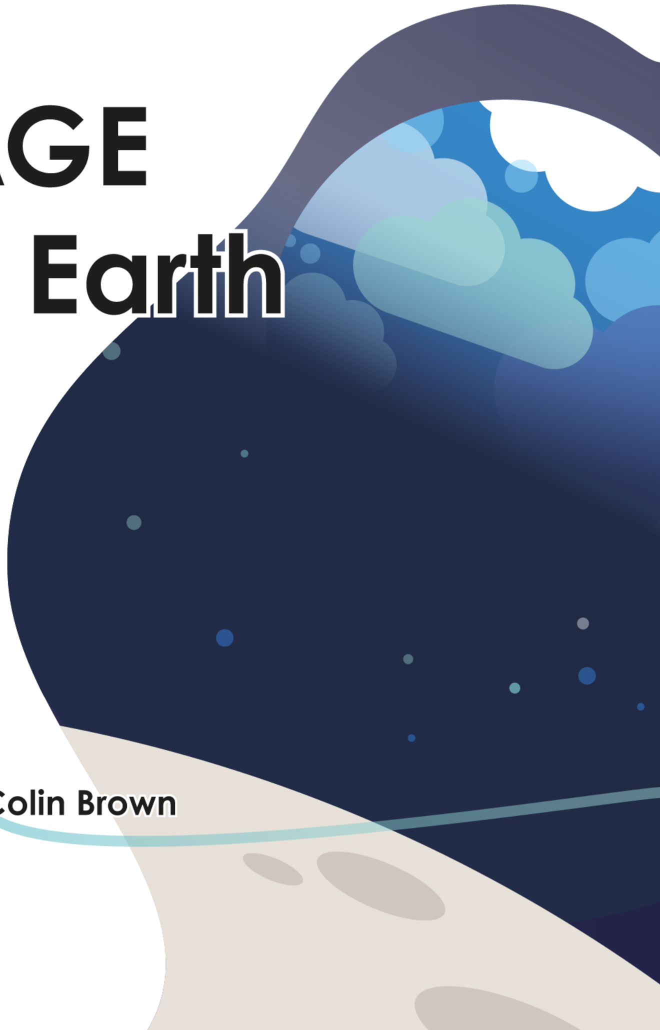
The Little Book of how to MANAGE Planet Earth



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Facing page image: Earthrise. Image credit: NASA

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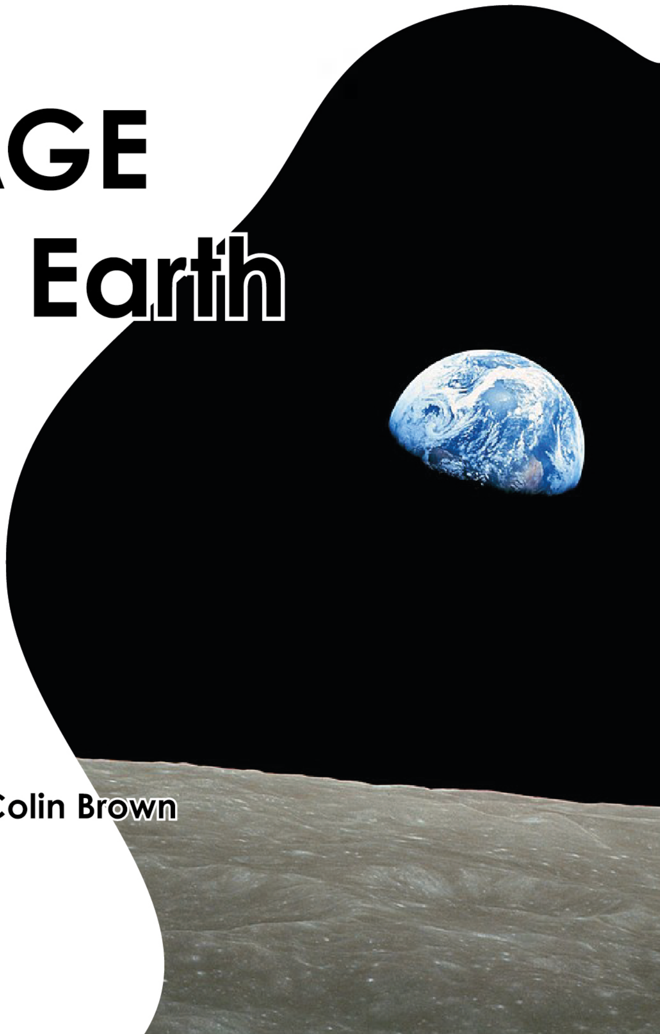

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Note to the reader

This Little Book is based upon Alison Stowell and Colin Brown's Chapter 13: Management of Sustainability, or How should we manage planet Earth? In Knights, D. & Willmott, H. (2022) *Introducing Organizational Behaviour and Management:* 4th edition. Andover: Cengage Learning, 500–546. This account provides a skeleton outline and we strongly encourage you to delve into the recommended books at the end.

Contents

What this Little Book tells you

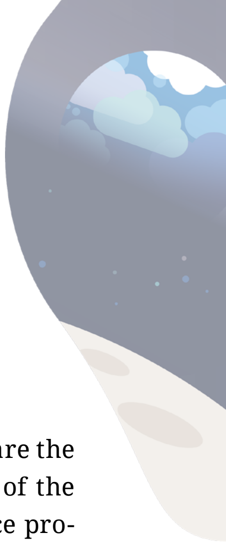
In this Little Book we will address the question ‘To what extent is it possible to manage the planet?’ We will:

- review the state of the planet and how this came onto the managerial agenda
- consider why this happened and
- suggest what could be done to improve the current state of affairs.

Our book will help situate the challenges and implications management face in developing sustainable approaches to planet Earth and their adequacy. Key concepts from environmental science and management literature will also be explained.

Key terms and definitions

- **The Earth System** is a **Complex adaptive system** that is materially closed and in which internal relationships, forces and feedbacks trigger change.
- **Sustainability** is a vision that includes the physical, social and economic environments that meet the needs of the present and future generations.
- **Business as Usual** is an approach that views the current state of the planet as a new economic opportunity to create competitive advantage.
- **Management for Sustainability** argues that organisations have to change, and that sustainability has to be embedded for better decision-making practices to take place.
- **Deep Ecology** is an approach that seeks to repair the rift between human beings and nature, recognises irreducible uncertainties and calls for radical change in the direction of contemporary society.
- **The Anthropocene** is a new geological era dominated by the influence of human activity on the planet.



The state of the planet

How did the planet come onto the managerial agenda? What are the problems we are trying to solve for the planet? As a result of the National Aeronautics and Space Administration (NASA) space programmes, environmental problems became far more visible in the West. In 1968, Frank Forman, Jim Lovell and Bill Anders broadcast the famous Earthrise image from the American Apollo 8 mission (see title page). It was the first time humans had seen planet Earth from afar.

The astronauts recounted how they felt, thought and made sense of what was happening:

> *"We'd spent all our time on Earth training about how to study the moon, how to go to the moon; it was very lunar orientated. And yet when I looked up and saw the Earth coming up on this very stark, beat up lunar horizon, an Earth that was the only color that we could see, a very fragile looking Earth, a very delicate looking Earth, I was immediately almost overcome by the thought that here we came all this way to the moon, and yet the most significant thing we're seeing is our own home planet, the Earth." (Bill Anders quoted in Poole, 2008: 2).*

This iconic image is credited with inspiring the 1970s American Modern Environmental Movement. People saw a fragile, beautiful planet, the only known system to support life in the solar system. As we know, today's picture is not the pure, fragile image the astronauts described. At the time of writing, Russia has invaded Ukraine, and we are going through a global pandemic.

How did we get to the point where we're reporting on and attempting to mitigate global risks, especially since socio-economic trends over the past 250 years have seemed extremely positive? Earth system scientists developed an Anthropocene Dashboard for assessing the state of the planet in terms of both socio-economic and Earth system characteristics.

The "Hockey Stick" graphs in Figure 1 illustrate the socio-economic trends in Figure 1a, and the Earth system trends in Figure 1b since

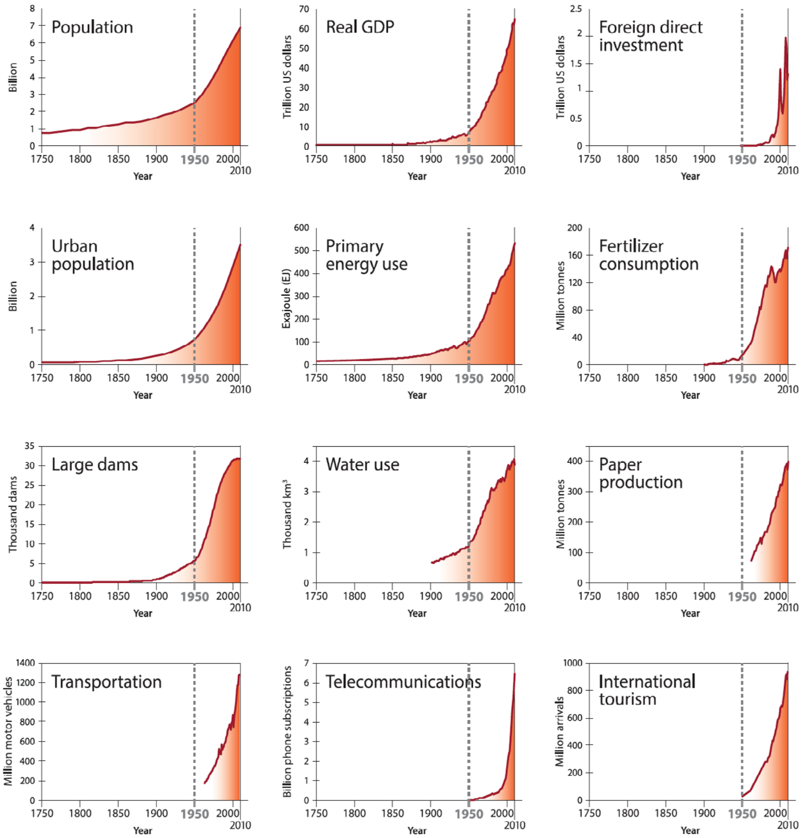


Figure 1a. **Socio-economic trends of the Great Acceleration from 1970 to 2010**[1]

[1] Source: Will Steffen *et al.* (2015) "The Trajectory of the Anthropocene: The Great Acceleration". Anthropocene Review. January 16. 2015.

the start of the Industrial Revolution (Steffen *et al.*, 2015). Looking at the socio-economic trends, global population, GDP and urban population are all expanding. Everything from energy use and dam development, to telecommunications and tourism has skyrocketed. Many of these qualities have made our lives better. Positive progress has been made by employing conventional management thought and practice (business as usual).

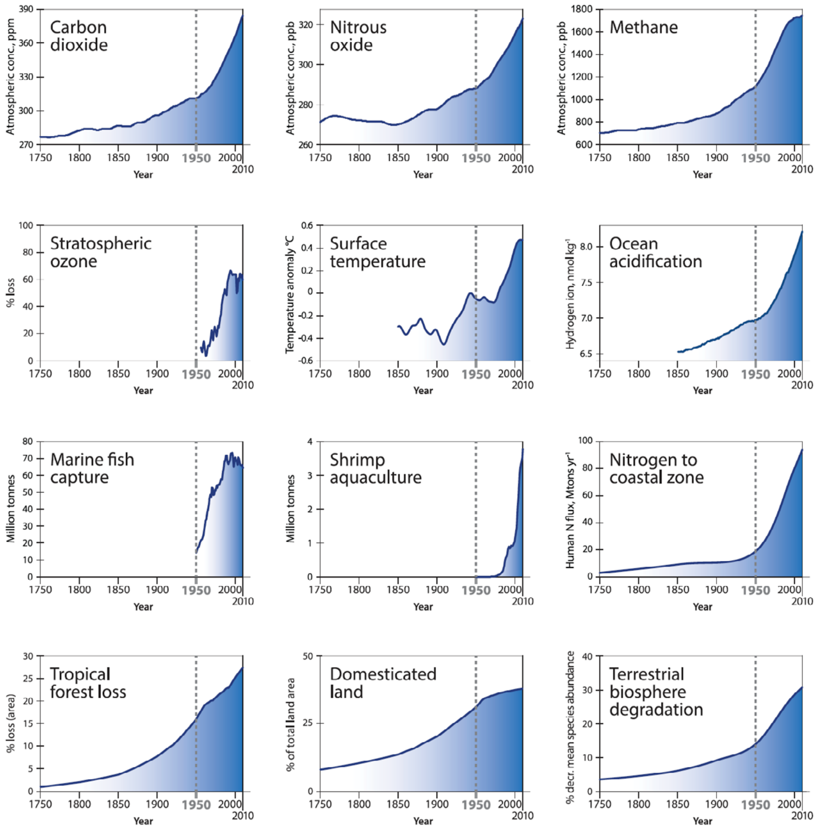


Figure 1b. **Earth system trends of the Great Acceleration from 1970 to 2010.**[1]

[1] Source: Will Steffen *et al.* (2015) "The Trajectory of the Anthropocene: The Great Acceleration". Anthropocene Review. January 16. 2015.

"The potential for feasible technological fixes or solutions to important issues such as energy, pollution, safety, and health should not be underestimated … The astonishing history of science and technology in the nineteenth and twentieth centuries shows that solutions to the physical needs of society have usually become rapidly available when those needs were perceived as urgent and feasible … one or more technological solutions will become available for pollution, traffic, resource, ecology …." (Khan, 1979: 240-241).

During the same period that these traditional management approaches dominated, Earth system indicators began to deteriorate. While many aspects of human lives have improved, the planet's temperature and biodiversity loss are both increasing.

The Planetary Boundaries is the most systematic representation of Earth system developments in business and policy. Earth system scientists and management experts agree that the planet must be managed within these boundaries to avoid catastrophic effects (Rockström *et al.*, 2009; Whiteman *et al.*, 2013).

Figure 2 illustrates nine boundaries, with the inner circle shaded in green to symbolise the safe boundary. The image reaffirms the detrimental consequences depicted in the Hockey Stick Graphs. Taken individually, the climate change boundary has already been exceeded, resulting in increased risk and uncertainty. In the 1980s, a substantial hole in the ozone layer emerged in Antarctica; nevertheless, we have made tremendous progress in reversing this depletion. Ocean acidification is accelerating, as is particulate pollution in the atmosphere. Deforestation, on the other hand, raises atmospheric carbon dioxide levels and increases the danger of zoonotic diseases such as Covid-19 and Ebola. The loss of biodiversity has reached an unsustainable level. Utilisation of fresh water is becoming more difficult as predictions of conflict over water security grow. The Haber-Bosch process disrupted the nitrogen and phosphorus cycles by removing nitrogen from the atmosphere (Angus, 2016).

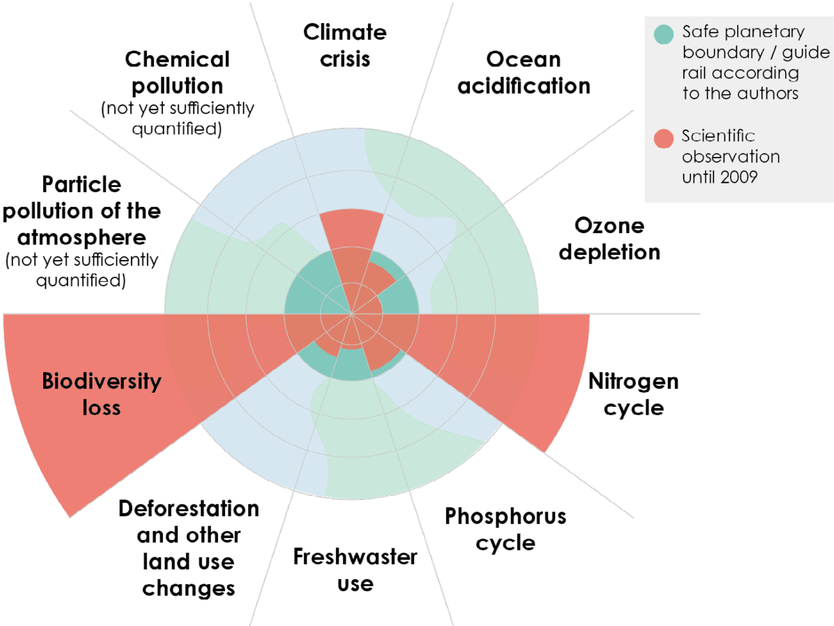


Figure 2. **Planetary Boundaries 2009**[1]

More recently, environmental scientists have developed an analysis of the emergence of the current Covid-19 pandemic. They indicate that we will see more epidemics the more we transgress the planetary boundaries. At least four of the nine boundaries are implicated in the appearance of Covid-19: climate crisis, deforestation, bio-diversity and air pollution (Malm, 2020; Rockström and Edenhofer 2020; Vinke *et al.*, 2020; Travaglio *et al.*, 2021).

A critical aspect of the Planetary Boundaries model is the frequent interconnection of the nine boundaries, sometimes in complex ways. Staying inside "the safe operating system for humanity" is the main difficulty. Looking at climate change and ozone depletion, the diagram for climate shows that we are not doing well in reducing emissions, whereas the diagram for ozone depletion shows we are making progress (Angus, 2016). How can we better comprehend the main reasons for success or failure?

[1] Source: © Felix Mueller, CC BY-SA 4.0.

Managing the ozone layer – a tame problem

We have shown that conventional management thinking and practices (a linear approach) have contributed to improving socio-economic characteristics during the last 250 years. The emphasis of a conventional approach is on clearly defining the problem and applying advanced causal analysis to the prediction and control of future environmental states. According to this view, prior to formulating acceptable policy solutions, we must first gather the requisite scientific truth. Such issues are referred to as 'tame challenges' in the policy-making literature and can be handled using 'the speaking truth to power' decision-making logic (Jasanoff and Wynne, 1998) in which science pursues truth independent of political concerns.

The ozone boundary is seen as an example of how to tame an environmental problem. As a result, this case is a narrative about the emergence, identification, theorisation and the imperfect resolution of an environmental problem.

The ozone layer forms part of the Earth's stratosphere that protects life on Earth by absorbing the sun's ultraviolet (UV) light which would otherwise be detrimental to human life.

In 1928, an American chemist named Thomas Midgely led a scientific team that made a number of breakthroughs, one of which was the discovery of ChloroFluoroCarbons (CFCs). CFCs were exploited by companies such as DuPont, an American chemical company, because these chemical compounds could be used to propel aerosols (e.g., hair spray), and in air conditioning and refrigeration units. At the time of Midgely's discovery, CFCs were believed to be safe and inert in that they did not interact with anything else (Angus, 2016).

CFCs were used from the mid-1930s until about the late 1970s when two things began to happen. First, three chemists, Molina, Rowland and Crutzen, pioneered stratospheric ozone research. Molina and Rowland predicted in 1974 that CFCs would damage the ozone layer. Next, Rowland asked the question, "if we are using these substances in aerosols and in air conditioning, what happens when we dispose of these substances?" Where is this CFC going?

It was assumed that the oceans absorbed CFCs, until independent scientist James Lovelock and his collaborators began to detect very low levels of CFCs in the atmosphere. Then the question became, "what are these CFCs doing if they are not in the ocean but are in the upper atmosphere?" (1979). Rowland and Molina's basic research demonstrated that CFCs will relentlessly break up ozone in a positive feedback system. UV radiation from the sun breaks up the CFC molecule, which then breaks up the ozone molecule, and this is a continuous process. Once it starts nothing necessarily stops it. This loss of ozone was observed in Antarctica a few years later.

The problem of loss of ozone has consequences for human health, such as increased risk of skin cancer. A hole in the ozone layer meant that UV radiation from the sun increased dramatically and caused a number of dysfunctions to the health of a variety of ecosystems, including human health.

In the mid-1980s, two significant national corporations who manufactured CFCs with considerable profits, DuPont and Imperial Chemical Industries, pressured their governments into ignoring claims that CFCs were harmful to the ozone layer.

The Montreal Protocol was signed in Montreal, Canada in 1987, and included 14 developed countries. This Protocol required these countries to limit CFC output by 50% by 2000. This was the start of a solution. The Protocol was then revised and strengthened nine times, including in 1990 in London, UK and 1992 in Copenhagen, Denmark.

The Antarctic ozone layer continued to be monitored, and a second, smaller hole was discovered in the Arctic. The Vienna Protocol was established in 1995, involving both developed and emerging countries, with the hope of closing the gap by 2008. The ozone layer was reported to be recovering in 1998, but not as fast as the Protocol signatories had planned. It should be noted that this is the only treaty that has ever been ratified by every country on Earth – 198 UN Member States.

In 2013, CFC levels were lower than in 1975, but in 2018, a sudden and unexpected surge in CFC levels was identified and related to East Asia (Cyranoski, 2019), and a new hole appeared over the Arctic (Witze, 2020). This is probably because regulation in itself is never enough. For example, if you get your car's air conditioning maintained in Spain, there's a 30% chance it'll be loaded with CFCs illegally imported from elsewhere (UNEP, 2020).

In 1980 we assumed, in a state of ignorance, that CFCs were perfectly safe, useful and inert. Rowland, Molina, Crutzen and others' research helped us to understand why the Antarctic's ozone layer was vanishing and made us doubt the safety of CFCs. The politics of uncertainty inhibited policymaking. We realised that if we did nothing, the risks to human health, ecosystems and the planet would be significant. Decisions were made that led to the 1995 Vienna Protocol. So, in around 20 years, we went from ignorance to effective policymaking. The perceived success was accomplished by effectively managing a 'tame problem' using a linear approach to policy making, based on the elimination of uncertainty within the conventional 'truth to power' model.

Managing the climate crisis – a wicked problem

In contrast to the relative success in managing the ozone layer, the situation regarding the climate crisis is different. We have been unable to stop the steady rise in carbon emissions. CO_2 levels today are 418ppm, compared to 280ppm in 1780. Our policy diagnosis starts with "wicked problems". Horst Rittel and Melvin Webber coined this phrase in 1973. They were urban planners from Los Angeles who were concerned about the city's growth. Wicked problems are unsolvable by the conventional approach of 'speaking truth to power'. As each problem is unique, there are many uncertainties in knowledge that are unresolvable in the short term, but solutions occur as a result of time and resource constraints. Also, the issue lacks clear boundaries and a clear solution, making it difficult to solve as there is no straightforward path to its resolution.

Rittel and Webber argued that there was necessary clumsiness in problem resolution, as multiple stakeholders are involved, (e.g., global governments, nation states, public, private and third sector organisations, citizens, indigenous communities and so forth) each of which has competing values and interests. This idea of a wicked problem has spread to policy circles, where multi-dimensional situations are common. According to DeFries and Nagendra (2017), eco-system management is a wicked problem. They show how to manage eco-systems effectively by avoiding two traps: assuming a tame solution is possible and that inaction is caused by complexity. To paraphrase influential American journalist Henry Louis Mencken from the 1920s, "for every wicked problem there is a clear, simple and wrong answer".

The unstoppable rise in CO_2 in the atmosphere has already altered the climate via the 'greenhouse effect', where heat from the sun is trapped on the Earth's surface, raising temperatures.

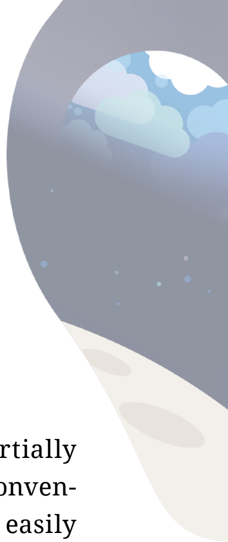
Charles David Keeling, an environmental scientist, was among the first to wonder what happened to all the CO_2 emitted since the Industrial Revolution. His plan was to set up a mountain top monitor in Hawaii, in the Pacific Ocean, far from any industrial activity, and this monitoring continues at the Mauna Loa Observatory. Keeling discovered that CO_2 started at 310–312ppm and increases every year. He provided a standardised way of measuring CO_2 levels over time, and this shows a steady rise from 312ppm in 1958 to 418ppm in 2022. The cause of this is widely accepted as fossil fuel consumption (Angus, 2016).

Despite recent efforts to reduce emissions, annual CO_2 increases of about 1ppm have continued. The 2015 UN Climate Change Conference (COP21) Paris Agreement, and subsequence COP meetings, set a goal to keep global warming within two degrees Celsius above pre-industrial levels and to get countries to agree on mitigation, adaptation and financial commitments. However, despite our knowledge of the effects of fossil fuels and our transition to a low-carbon economy based on clean renewable energy (wind, water, solar), we have gone from 310ppm to over 418ppm, indicating an unrelenting rise in CO_2.

The fact that CO_2 levels are still rising raises important questions of global equity and justice. US citizens produce 14.95 tonnes of CO_2 per year versus 1.6 tonnes in India (Statista, 2019). Some countries, like Malawi or Somalia, have zero.

We can see that conventional management practices can ‘tame’ some environmental issues. However, we have shown that ‘wicked’ problems present a new management challenge, and that new thinking and practices are required to reverse the Earth system’s negative trends.

Understanding the drivers of the current state of affairs should provide an opportunity to explore how we might begin to develop different practices that could help provide solutions.



Why has this happened?

How the current state of the planet developed can be partially attributed to management education, as this has reinforced conventional thinking and practice, based on the belief that we can easily fix environmental problems. Often the teachings and research are based on assumptions that the natural environment is an externality. Efficiency and predictability are necessary requisites in organisations, competition is key and business models/economics are based on competitive linear growth.

To better understand the natural world, environmental studies and politics professor David Orr (1992) argued that management courses needed to become eco-literate. Using technology to solve environmental problems has limits. We need to develop a steady state economics, and sustainability and ethical analysis should be fully integrated into management education. Orr asserted that, if management education incorporated all of these principles, we could develop a very different organisational style.

No one academic discipline has all the required knowledge when responding to the management of the planet, which is why a trans-disciplinary approach is called for to try to manage wicked problems. This Little Book combines three disciplines: environmental science, management studies and science and technology studies. Environmental science has developed an Earth system science that views the planet as a living, complex adaptive system (Steffen *et al.*, 2004). Management research helps us understand environmental issues, challenges and solutions. Finally, science and technology studies help us understand how scientific knowledge is generated, validated, developed and used to inform management decisions.

The emergence of the Anthropocene

The work of geologists and environmental scientists can help us understand our time on Earth and our Earth system interaction (Lewis and Maslin, 2018). This interaction has three epochs in the last two million years:

- Hunter-Gatherers, up to 9,000 BC
- the Neolithic Revolution (late Holocene) 9,000 BC to 1945 AD
- the Anthropocene since 1945

In the first epoch, until 9,000 BC, we were nomadic hunter-gatherers who lived in small groups on the African Savanna before spreading out across the globe. We never stayed in one place for long, didn't grow food and lived off the land. We left when the environment no longer fed us. During this time period, the climate was highly variable in temperature.

The second Neolithic epoch began around 9,000 AD, in the late Holocene. Then, we settled in what is now Iraq and Syria, in the Fertile Crescent. We began to settle for long periods of time, to build our first cities, to cultivate wheat and rice and then began to more systematically harm the natural environment. Up until 1945, the population and climate were relatively stable. No major catastrophes occurred during the ice ages. During this time, we spread out of the Fertile Crescent and developed similar agricultural societies. We entered the Anthropocene era in 1945, when humans began to develop a very different relationship with the planet (Angus, 2016).

In the Earthrise image (see title page), it appears relatively pristine, but in 2017 planet Earth looked very different. Figure 3 shows the Earth surrounded by broken satellites and rocket parts. Human waste surrounds us, causing a variety of issues. We must, for example, hope that none of these objects collide with the satellites that ensure our mobile phones work.

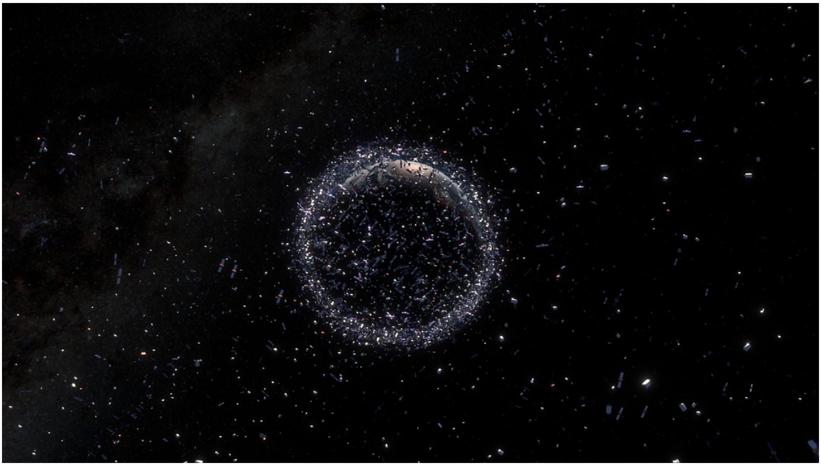


Figure 3. **Space Debris 2017**[1]

These images from space powerfully depict how humans have impacted planet Earth in the Anthropocene. Although the start date is debated, for our purposes, the Anthropocene begins after World War II (WWII), in 1945. Earth system scientists say this is the most convincing start date for the Great Acceleration (Steffen *et al.*, 2011; 2015).

After 1945 and WWII, the Westernised economies came out of depression and dramatic changes occurred. Consumption of fossil fuels increased, as did the number of cars (40–70 million) and household income. War no longer slowed globalisation as resources from Australia, South Africa and Chile were traded and transported (metals and plantations). During the war, we saw an increase in scientists and technologists, as well as new partnerships between governments, industry and academia (Steffen *et al.*, 2011).

Changes accelerated as the Anthropocene entered the 21st century. Looking at the Anthropocene Dashboard (Figure 1), we can summarise the impact in five points (Steffen, *et al.*, 2004; 2011):

- life expectancy is rising rapidly
- CO_2 levels have increased from 300ppm in 1945 and now approaching 418ppm, exceeding a one-degree centigrade rise

[1] Source © ESA/ID&Sense/ONIRXEL, CC BY-SA 3.0 IGO

- population growth
- continuous economic growth as measured by GDP
- better nutrition and living standards

So, how do we live longer and better lives without harming the planet?

The Earth system as a complex adaptive system

The planet has supported life for 3.5 billion years and is the source of the Planetary Boundaries approach. Steffen *et al.* (2004) summarise this relationship in five points.

First, the interaction of physical, chemical, biological cycles and energy fluxes allows for life on Earth. Planet Earth has been around for 4.5 billion years. For the first 2 billion years, only single-celled organisms existed.

Second, the planet is a materially closed system, except for the sun. The sun's power has increased by about 20% over the planet's lifetime, while its temperature has remained fairly stable. The planet's atmosphere, which produces the greenhouse effect, is vital in keeping the temperature at a level that supports life.

Third, humans are now an integral part of the system. There is a significant difference between the state of the planet before and after human evolution and this is important because of 'anthropogenic change'. Humans cause change, which interacts with natural variability, causing the planet's temperature to fluctuate over time.

Fourth, the planet is a complex dynamic adaptive system in which internal forces and feedbacks trigger changes to occur within the materially closed system. When change occurs on the planet, it is largely due to the internal relationships and interactions indicated in the first point. While external factors do occur, these are of lesser importance.

Finally, in the theory of complexity, many changes are not predicable. Thresholds are crossed and nonlinearities occur rapidly, this means 'tipping points' or 'surprises'. The system can be in a stable equilibrium before suddenly changing states. It reaches a tipping point where the system is fundamentally altered and we can't accurately predict such changes. A complex adaptive planetary system has this trait.

Complex adaptive systems and complexity thinking

What do we mean by a complex adaptive system? This question can be answered by considering three types of systems (see Table 1) – simple, complicated and complex.

***Table 1.* Complex Systems and Complexity Thinking**[1]

Simple system/ thinking e.g., following a recipe	Complicated system/thinking e.g., sending a human to the moon	Complex system/ complexity thinking e.g., raising a child
The recipe is essential	Formulae are critical and necessary	Formulae have only limited application
Recipes are tested to assure replicability of later efforts	Sending one mission increases assurances that the next will be ok	Raising one child gives no assurance of success with the next
No particular expertise, knowing how to cook increases success	High level of expertise in many specialised fields require coordination	Expertise can help but is not sufficient as relationships are key
Recipes produce standard products	Missions are similar in critical ways	Every child is unique
Certainty of the same results every time	High degree of certainty of outcome	Uncertainty of outcome remains, and surprises occur

[1] This table was developed from a personal communication with Colin Brown and the late Professor Brenda Zimmerman

To explain a simple system, if 50 people are given the recipe, ingredients, cooking utensils and stove to cook an omelette, the results will differ due to the individuals' skills and behaviours.

One person will make a great omelette and another will make a shambles. However, the bad omelette maker could improve by asking the more skilled omelette maker to show and teach them — the process of apprenticeship. This simple system can be easily managed if the recipe is valid. No special skills are required, as practice and time will yield a standard product. Replication and predictability are the managerial challenges here.

A complicated system raises the managerial stake but it shares many similarities with the simple system. The key formulae that are critical for success can be thought of a bit like a recipe. We need to know how to build a lunar landing device for a space rocket that can accelerate enough to escape Earth's gravity. Many of these challenges require scientific and technological knowledge. Like the simple system, once we send a mission to the moon, we can probably do it again. But there have been failures, such as rockets exploding. The managerial issues are much more challenging.

To put a man on the moon, NASA needed to be able to coordinate different expertise. People who built rocket engines, space suits and understood how to feed people in space had to work together. Many NASA case studies explain how coordination between various activities came about (Feynman, 2020). But things went wrong, like when the Space Shuttle Challenger broke apart in 1986. In this case, the engine 'O-ring' seals failed due to a lack of coordination between engineers and managers. As a result, the managerial lessons focussed on how to avoid similar failures in the future by better coordination of expertise (*ibid.*). Compared to a simple system, a complicated system requires more expertise and coordination. Much conventional management thinking and practice has developed to focus on complicated systems, and we are generally successful at managing them.

Complex systems change the game. For example, is there a formula for managing the system of raising a child? Many books have been written about it proposing different parenting strategies, but there are no set rules for raising a child. Also, as a parent, you cannot assume that just because one child is successful, another will be as well. Expertise also plays a role. If you are a parent having issues with your child, you can consult an education psychologist or a counsellor. However, experts may disagree on the best course of action, so you have to make a judgement call. As each child is unique, there is always some uncertainty.

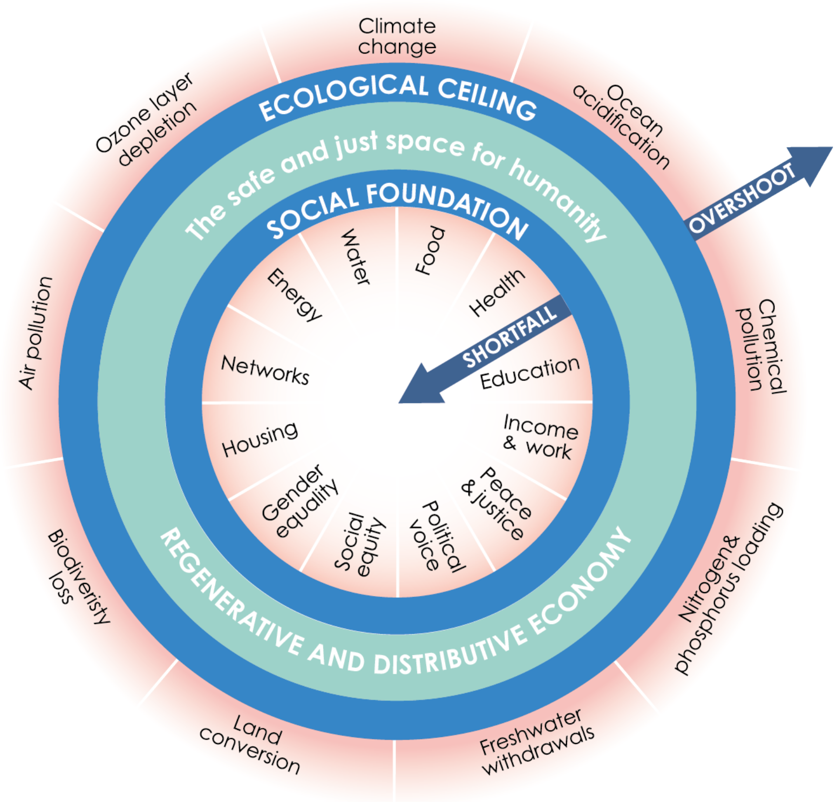


Figure 4. **Social boundaries and safe operating systems**[1]

[1] Source: © DoughnutEconomics – Own work, CC BY-SA 4.0.

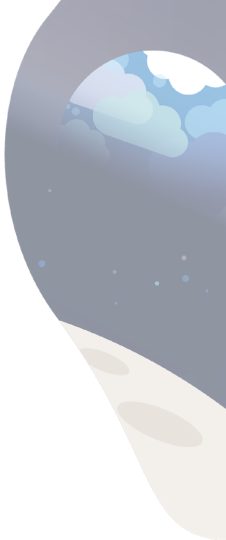
Simple and complex systems require different ways of thinking and acting. Conventional managerial thinking and practice won't work with complex systems. The challenge is daunting because the planet is a dynamic complex adaptive system in which many future states (equilibria) are possible but difficult or impossible to predict.

Economist Kate Raworth challenges conventional management thinking. She suggests incorporating social dimensions into the Planetary Boundaries framework. Creating an economy that meets the needs of all within the planet's boundaries, she argues, requires more. Management decisions should not only consider how to stay within the safe operating system, but also how to help individuals meet the UN's 17 Sustainable Development Goals.

Raworth is not the only one criticising conventional managerial thinking and economics. Herman Daly started it in the 1980s with steady-state economics. Dasgupta, quoted below, also raises two points. First, he criticises the use of GDP to measure economic growth and shows how GDP growth can actually undermine wealth. Second, on economic externalities:

> *"the side effects of human activities that are undertaken without mutual agreement are called 'externalities' by economists … The example suggests that the externalities involving the environment are mainly negative, implying that the private costs of using natural resources are less than their social costs. Being under-priced, the environment is over-exploited." (Dasgupta, 2007: 483).*

Returning to the boundaries, Rockström *et al.*, (2009) and Raworth (2017) argue that "management is identifying a safe operating space for humanity". There are both positive and negative signs. In this way, mainstream environmental science and economics have systematised the situation of the planet.



What should we do about this?

The main issue management faces in developing Earth-friendly strategies is how to manage the Earth as a complex adaptive system. It is inherent in such systems that there will be surprises in the state of the system. We use insights from both management and environmental disciplines to extract ‘good to think with’ concepts. As a result, we’ll describe three different ways of managing the planet, based on framing assumptions employed in the management literature.

For broader context, we must first consider the contemporary decision-making context.

Funtowicz and Ravetz’s work is an important development of complexity theory and a challenge to conventional policymaking approaches. Consider the following quotation from Danish Prime Minister Anders Fogh Rasmussen, addressed to policy delegates at the Climate Change Conference in Copenhagen (COP15) in December 2009.

> *“... science should be the basis for decision-making in this field ... not to provide us with too many moving targets ... and not too many considerations on uncertainty and risk and things like that.”*

Here, Rasmussen is seeking a tame solution to a wicked problem. On Funtowicz and Ravetz's analysis, we often need to move away from reliance on a 'truth to power' model where there is scientific closure, to a more realistic description of contemporary managerial decision-making realities associated with complexity and wicked problems. They define the contemporary context in terms of four characteristics: that facts are uncertain, values are in dispute, the stakes are high and decisions are urgent.

Considering the current state of climate change, these seem to accurately describe our predicament. The stakes are high because, if we make bad decisions now, we will suffer in the long run and, if we do nothing, the problem will worsen.

Post-normal science acknowledges that scientific knowledge is incomplete (Hulme, 2009). So, while we can't unambiguously develop effective policy, management must figure out how to operate in this situation. Wicked problems require solutions with on-going collaboration between stakeholders, recognition of ignorance and sophisticated risk-management techniques.

Policy options

Karp and Gaulding (1995) outlined three generic policy options. First is command and control, where regulations are made and then enforced by law. Second, is the market policy option premised on choice, where we use the market system to create new incentives through taxation that make people want to change their behaviour. Third is voluntarism, a policy option that achieves altruism or compliance through normative pressures.

The political preferences of these three basic policy strategies vary and they are not mutually exclusive. We must also consider the level of intervention within any system we wish to change. Should we focus on individual behaviour (like recycling) or global institutions? Where do multinational organisations stand in relation to national governments in controlling carbon emissions?

How should we manage planet Earth?

We saw that state regulation, market-driven policies, or a mix of the two, were popular approaches but what is the best approach? The answer lies in our prior basic assumptions. We disagree about how we think about particular important issues. These include:

1. how we think about the relationship between human beings and the natural world
2. what we think sustainability means
3. whether sustainability can be achieved within the capitalist economic system.

These are the framing assumptions that determine our preferred management approach. Business as Usual, Management for Sustainability, and Deep Ecology are three distinct approaches to managing the planet. Each of these approaches has a consistent set of assumptions and tells a distinct and compelling story. Let's look in more detail at these three framing assumptions and how they differ.

Value positions – the four myths of nature

Perhaps the most fundamental framing assumption concerns different views of the current state of the natural world. Many consequences follow from our choices here.

> *"The rise of climate scepticism is increasingly being recognised, not as a scientific debate about evidence and explanation, but rather a normative debate deeply skewed by beliefs and values occasionally by cynical self-interest." (Steffen et al., 2011: 861).*

We need to identify the particular beliefs and values in play here. Drawing on science and technology studies, more specifically cultural theory, provides one way to explain the disparity between perceptions and explicitly discusses issues of identity, collectivism and power.

According to this theory, beliefs and ways of organising social relations are mutually reinforcing. Beliefs about nature are used to justify certain lifestyles, but these social structures are also used to justify particular sets of beliefs (Schwarz and Thompson, 1990). The term ‘myth’ simply refers to the ways in which social groups filter facts and the way these facts are pulled together to create a narrative about how the world is and how we should live within it. Each quadrant in Figure 5 illustrates how different cultures and social groups view nature (*ibid.*).

Starting with the bottom left quadrant and the myth that nature is benign, the world is wonderfully forgiving and fully resilient. Management practices here would be relaxed as we can do what we want within wide limits. The cup and ball image implies that the cup can be shaken, but the ball will not come out as the cup is deep. Nature has been self-sufficient for 4.5 billion years and will continue to be so. We can continue to do ‘business as usual’ because nature will tolerate our actions.

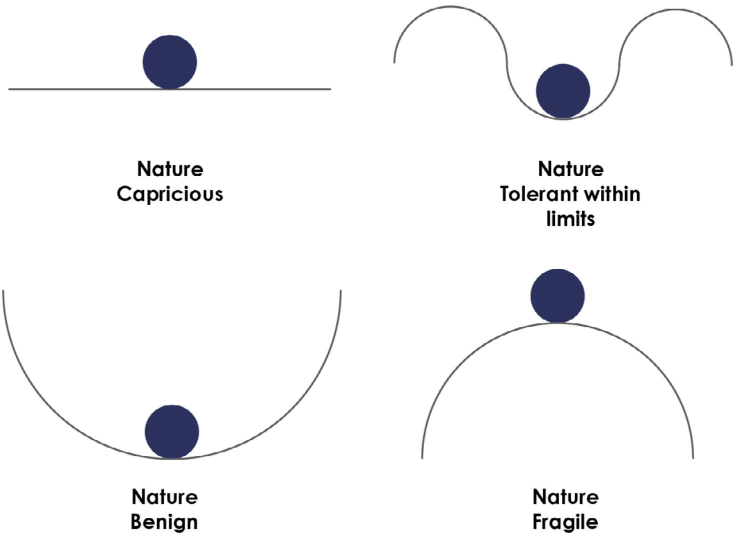


Figure 5. **Four rationalities (Myths of Nature)**[1]

[1] Adapted from Schwarz and Thompson (1990: 7) Divided We Stand: Redefining Politics, Technology and Social Choice. Philadelphia: University of Pennsylvania Press.

The myth of nature's tolerance, top right quadrant, is a view that the planet is forgiving but vulnerable. Shake this system and tipping points and surprises could occur. The boundaries models are the crucial indicators here (Rockström *et al.*, 2009; Raworth, 2017). The idea is that we can stay within the cup's limits if we manage the planet properly. Unstable conditions can cause the ball to fly out of the cup and into danger.

In the bottom right quadrant, where the myth is of nature as fragile, we are in a dangerous situation, close to tipping points, where one small jolt could create catastrophic effects. Whatever we do, we need to be careful and alter our current emphasis on continuing economic growth.

Finally, the top left quadrant shows nature as capricious. This is the belief that we are unable to effectively manage planet Earth and must instead adopt a fatalistic approach to the current situation. This position resonates more strongly in some eastern philosophies.

These four myths of nature represent diverse ethical positions in terms of the relationship of human beings with nature. Recognising these different myths is useful from a management perspective in that each position distils some wisdom that could be missed by the other social groupings in seeking effective management solutions (Verweij *et al.*, 2006). To create fair and balanced solutions, opposing value propositions must be considered (e.g., post-normal science – values are in dispute).

Conceptualising sustainability

Sustainability is a heavily contested idea with various meanings. The earlier usages can be traced back to the management of forests in Europe (Hediger, 1997; Grober, 2015). In order to design a sustainable forest management system, a yield must be taken that can regenerate itself indefinitely. If we cut down too many trees, the forest will decline and become unsustainable. In 1987, the United Nations Brundtland Report defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987:43). This is the conventional way of understanding sustainability. This definition alerts us to the idea that the way we live our lives should not detract from the possibility of future generations enjoying equal benefits, which raises the important ethical question of inter-generational justice.

In 1992, Stead and Stead argued that management needs to take the ideas of sustainability on board, change their approach and create a critical mass to drive sustainable management.

In 1994, a now well-known representation of the different meanings of sustainability was put forward by John Elkington's Triple Bottom Line (TBL). Figure 6 illustrates the three central components of sutainability – environmental, social and economic.

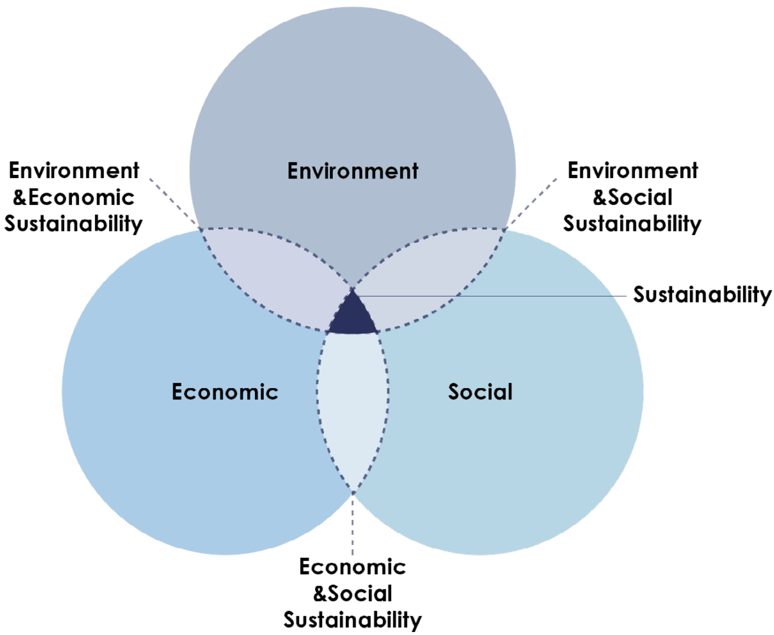


Figure 6. **Graphical representation of John Elkington's 1994 Triple Bottom Line concept.** [1]

[1] Adapted from Elkington, (1997) Cannibals with Forks: The Triple Bottom Line of 21st Century Business. Minnesota: Capstone.

First, economic sustainability recognises that organisations have to make a profit to survive. It is therefore concerned with the survival of organisations in the competitive economy and the maintenance of economic growth.

Second, social sustainability is concerned with how we can organise ourselves and our communities in such a way to ensure everyone survives and thrives.

Third, environmental sustainability is linked to maintaining ecosystem services and avoiding planetary boundary violations. Figure 6 shows that there is overlap and that, to achieve true sustainability, social, economic and environmental considerations must be given equal weight.

The economic literature's distinction between weak and strong sustainability is critical to our analysis (Hediger, 1999). A society's wealth is measured in terms of natural, human, manufactured and institutional capitals. In terms of sustainability, how much can we substitute one type of capital for another? For example, blasting a highway through the Amazon rainforest depletes natural capital. However, we may increase other forms of capital, such as manufactured capital, human capital and institutional capital, as Brazil grows richer and strengthens its institutions.

In weak sustainability, there is an assumption that these four types of capital can all be substituted for each other. Industrial society has been successful in the way it has done this because it has substituted natural capital, which is by and large degraded, for other forms of capital, e.g., human capital.

If weak sustainability argues that all of these capitals are substitutable, then natural capital can be depleted and leave the next generation with a different balance of capitals but still have the same, or increased, wealth. Against this, strong sustainability economists argue that there are limits in that you cannot continue to substitute or deplete natural capital at the expense of other capitals, because natural capitals are finite (Costanza, Daly and Bartholomew, 1991).

A final framing challenge

Angus (2016) uses the term 'metabolic rift' to pose an important query. Can strong sustainability be achieved in today's capitalism? Almost all of this book assumes that the answer is yes.

However, historical and political literature contends that current economic arrangements do not allow for strong sustainability. These approaches are called "eco-socialism" (Angus, 2016) and "world-ecology"(Patel and Moore, 2018). Let us use the human body's cancer as an example of a metabolic rift (Angus, 2016).

Cancer disrupts the body's metabolic system. Cancer cell growth consumes energy, provides no benefit to the body and the metabolism is disrupted. Allowing this malfunction to continue will eventually overwhelm the body and may be fatal.

Applying this idea to the ecologies of the Earth system, these authors argue that capitalism creates a rift in the Earth's ecologies by disrupting the global metabolism and converting energy into capital via disruptive extraction technologies (called "cheap natures" by Patel and Moore, 2018).

Three positions for 'managing planet Earth'

> *"All things that we can see, touch, need or desire are either part of the environment or have been produced from resources extracted from the environment." (Roberts 2011: 6).*

Business as Usual (BAU), Management for Sustainability (MfS) and Deep Ecology (DE) are three broad approaches to managing planet Earth. Table 2 shows how each approach is framed differently. While there are debates and subtle differences within each position, we will focus on the underlying assumptions. Each approach claims to be able to effectively manage planet Earth and develop new management thinking and practices.

Table 2. **Three approaches to 'Managing the Planet'.**

Business as Usual (BAU)	Management for Sustainability (MfS)	Deep Ecology (DE)
New business opportunities	New business values	Industrial Society is at war with the planet
Nature as robust/ benign	Nature as tolerant, within limits	Nature as fragile
Economic sustainability (orthodox economics)	Weak sustainability (market solutions/ carbon taxes/ environment economics)	Strong sustainability (ecological economics)
Market utilitarianism	Ecological modernisation	Post-materialism
Nature/Society dualism	Nature/Society dualism	Rejection of dualism - Holism

Business as Usual – conventional strategic management

Remember Herman Khan's quote at the start of this book? This quote exemplifies the optimism shared by conventional management thinkers. The success of NASA's programme to put humans on the moon fuelled this optimism. The development of geoengineering or carbon capture as possible solutions for pollution, traffic, resource, ecology and similar problems has partially realised Khan's belief in technological solutions.

According to the BAU, the current state of the planet presents new, competitive opportunities. Consumers want to know where their meat comes from and that their washing powder does not pollute the environment. Consumers need to be convinced to buy new products and services. These new opportunities are provided by nature.

> *"Managers of publicly traded firms have a fiduciary responsibility to adopt 'green management' practices only if such actions complement the organization's business and corporate-level strategies. They should not engage in*

> *such activities for 'moral' reasons or in response to societal pressure alone, but rather in response to a legitimate demand for green management practices from groups (e.g., consumers) that can directly benefit the firm." (Siegel, 2009: 5).*

According to Siegel, management should approach sustainability as an opportunity.

So how can management carry on as usual while the range of environmental indicators deteriorate? One answer is that business and management education fails to develop ecological literacy, and there are several reasons for this.

First, there is a limited amount of environmental legislation and many regulatory failures. Second, existing accounting practices fail to focus upon negative externalities or eco-system services. Common cost-benefit analyses often ignore environmental impacts, and the future state of the environment is severely discounted. Third, green politics is generally ineffective. In 2022, only one of 650 UK MPs is Green.

Fourth, the uncertainty of scientific knowledge prevents the use of the 'truth to power' model in decision making. The link between smoking and cancer was discovered in the UK in the 1960s but government action took another 20 years because tobacco companies were a powerful lobby group that emphasised uncertainty in knowledge to further their own interests. Climate change deniers, especially in the US, remain a powerful force.

Fifth, the use of GDP as a growth indicator often obscures environmental issues. For example, the 2010 BP Deepwater Horizon oil spill in the Gulf of Mexico boosted the American economy despite extensive environmental damage (Di Leo, 2010), demonstrating that current environmental and social metrics are inadequate (Pilling, 2018).

Sixth, are the assumptions that human beings are inherently selfish, self-interested and, given a chance, they will exploit the environment for their own ends. This assumption is central to BAU economic modelling.

The socio-economic benefits of the past 250 years seem to owe much to the effectiveness of BAU, but the drive for efficiency and cost reduction can have unexpected and dangerous effects.

Management for Sustainability and Deep Ecology scholars contend that this approach will not solve most environmental issues.

Management for Sustainability

> *"First, the earth has serious environmental problems that cannot be ignored, and many of these problems are directly related to the way humans think about and practice business.*
>
> *Second, responsible business in the 1990s and the 21st century should be conducted within the limits of the eco-system …*
>
> *Third, there are new, more realistic, ways of thinking about the relationship between business and the ecosystem and these new values are based on the values that, when incorporated into the strategic management process, can be beneficial for both long-term survival of the firm and the long-term survival of the Earth." (Stead and Stead, 1992: 190).*

According to Stead and Stead, both ecosystem and business survival are possible, but we need to take sustainability seriously. The World Business Council for Sustainable Development (WBCSD) is an example of this approach, bringing companies together to transform business. Better investment and product development decisions can be made if sustainability is built into the organisation's strategy. Nature is viewed as a stakeholder who must be involved in all decisions.

How can we move towards sustainability? There are numerous techniques and approaches commonly used in MfS such as ecological footprint, ecological modernisation, geo-engineering and the circular economy. Given the size of this Little Book, we only have space to focus on one and that is the circular economy, chosen due to the current industrial and policy momentum.

Circular economy has emerged as a key principle for environmental and industrial policies in the last decade. In China (Winans, Kendall and Deng, 2017) and the European Union (European Commission, 2018), corporations and local governments quickly adopted the ideas (Lacy, Long & Spindler, 2020). The goal of this new economic model is to create circular flows of materials rather than the current wasteful linear flow of materials (Corvellec *et al.*, 2020). The Ellen MacArthur Foundation, a UK charity and think tank, uses a widely accepted definition.

> *"The circular economy is one that is restorative and regenerative by design and aims to keep products, components, and materials at their highest utility and value at all times, distinguishing between technical and biological cycles." (EMF, 2015: 1).*

The circular economy promises to reduce environmental impacts by lowering energy consumption, greenhouse gas emissions and increasing resource security, a narrative that management can relate to (Esposito *et al.*, 2018). Circular economy promises economic growth by lowering production costs and creating positive social impacts through access to lower cost product and services, a healthier environment and the creation of new jobs. Finally, there are many opportunities to innovate to improve materials, labour and energy efficiency (EMF, 2015; WBCSD, 2017; Circle Economy, 2020) through virtualisation or technological developments such as 3D printing or Apple's Recycling Robots Liam and Daisy.

This shift necessitates organisations adopting new business/operational models (Esposito *et al.*, 2018). Some examples of 'building products to last' are Fairphone, who create sustainable smartphones. Others include resource recovery that considers reuse (upcycling/downcycling), remanufacturing, refurbishment and recycling; sharing platforms that foster collaboration, such as Hitachi's collaborative logistics, or construction equipment hire. Finally, there are models that shift consumers to users where performance is viewed over ownership such as Philips Lighting Service for Business, a Dutch technology company that designs, builds and maintains light solutions for a monthly fee.

In summary, the circular economy is a contemporary example of how management can address environmental issues while promoting sustainability.

So, MfS emphasises the need to develop new practices in the move towards weak sustainability. Nature is viewed as amenable to safe operating systems. Complexity and uncertainty are recognised, and the possibility of uncertainty reduction through sophisticated enquiry is sought. To achieve the required system transformation, it is necessary to bring together diverse voices, cultures and values.

Deep Ecology

> *"The future cannot be a continuation of the past, and there are signs … that we have reached a point of historic crisis. The forces generated by the techno-scientific economy are now great enough to destroy the environment … The structures of human society themselves, including even some of the social foundations of the capitalist economy, are on the point of being destroyed by the erosion of what we have inherited from the human past. Our world risks both explosion and implosion …" (Hobsbawm, 1995: 584-5).*

British historian Eric Hobsbawm predicted the Anthropocene's fundamental characteristics. "The forces generated by the techno-scientific economy" are the forces which drove the Anthropocene and are considered powerful enough to harm the environment. This rather pessimistic view says our world is in danger of collapsing.

The deep ecology (DE) approach is found in political economy and eco-social literatures rather than management textbooks. The approach is deeply critical of existing industrial society and is characterised by the phrase "industrial society is at war with the planet”. Radical reform is required, based on complexity theory and a different view of human nature — the Ecological Self (Næss, 1973; Angus, 2016; Raworth, 2017; Patel and Moore, 2018).

DE offers a critique of management for sustainability. From this perspective, MfS will not function and may worsen the condition (Angus, 2016). Much of it is seen as ‘green washing’, sustaining unsustainability rather than managing it. This is because MfS still accepts many aspects of contemporary civilisation, talk of institutional change and new technical breakthroughs will never be enough to fix Earth system indicators.

From the DE perspective, the planet is viewed as fragile, and any new sustainable trajectory must be approached cautiously. Much has to change for strong sustainability (Patel and Moore, 2018).

The Norwegian philosopher Arne Næss coined the phrase “deep ecology” and argued that, if businesses and governments had a “true understanding of nature” as opposed to viewing it as a useful resource separate from humans, this would enable a better appreciation of the value of biological diversity (Næss, 1973). Many environmental issues stem from the dualist division of nature and civilisation. Over the years, the idea that humans are separate from nature and are therefore able to rule it has led to a succession of disasters. Patel and Moore (2018) argue that dualism led to western slavery. As a result, the Spanish conquistadors saw the indigenous South Americans as ‘naturales’, or ‘part of nature’, and a resource to be exploited (like coal or sugar). Humans must be considered as part of nature by deep ecologists, otherwise environmental issues will remain unresolved. Natural systems, including humans, should be understood as whole systems, not as components. Embrace post-materialism by seeking spiritual values, equality and sustainability, which address the needs of all — both human and non-human.

DE offers a powerful analysis of the reasons behind the Dashboard of the Anthropocene but is light on action plans for the future.

Conclusion:

Is it possible to manage the planet?

> *"To put it crassly … consumers want consumption sustained. Workers want jobs sustained. Capitalists and socialists have their 'isms', while aristocrats, bureaucrats, and technocrats have their 'cracies' … No one can publicly advocate unsustainable progress and maintain credibility. Thus, sustainability calls to and is being called for by many, from tribal peoples to the most erudite academics from peasant farmers to agro-industrialists, from denim-clad eco-activists to pinstripe-suited bankers. With the term meaning something different to everyone, the quest for sustainable development is off to a cacophonous start." (Norgaard, 1994: 10).*

It is a matter of opinion as to whether we have made any progress since 1994.

So, how do we manage the planet sustainably and balance the fact that we have gotten richer, live longer and have better lives, without this coming at a cost to the Earth system? (Steffen *et al.*, 2011; 2015). We know that conventional management practices have contributed both positively and negatively to the dashboard of the Anthropocene (Figure 1a and 1b). The Planetary Boundaries framework is a systematic way to assess the state of the planet and the possibility of tipping points in the complex system. If these tipping points are reached there will be points of no return. For example, the loss of biodiversity is largely irreversible and possibly permanent (Rockström e*t al.*, 2009; Raworth, 2017). We need education to become more ecologically literate and to use insights from other disciplines, most notably Earth system science, and science and technology studies.

The current state of the planet is largely attributable to our industrial progress, fuelled by innovation and technology. Our planet is a complex adaptive system that cannot be traditionally governed. Managerial decisions can no longer be based on a reductionist science that seeks predictability. Better decision-making will require new attributes, including conviction, boldness and commitment. How should we distribute risk and resources ethically? In terms of action, deep ecology gives the most severe appraisal of our current condition. Business as usual is full of action but understates the current threat. Management for sustainability sits between the two.

You must decide on the suitability of each of these three approaches and their ability to effectively manage planet Earth.

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